THE PREDICTIVE ABILITY OF CERTAIN CRITERIA OF SUCCESS IN GRADE TEN HONOURS MATHEMATICS

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by

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ABSTRACT

Purpose

There were two purposes for the thesis. The major purpose was to determine the predictive efficiency of the Science Research Associates High School Placement Test Educability score, Reading score, Modern Mathematics score, Science Methodology score, and Composite score, as well as the predictive efficiency of the grade nine mathematics mark received by each student in predicting success in the grade ten Honours course.

The secondary purpose of the investigation was to determine if the school which a student attended prior to coming to Brother Rice High School had any effect on his performance in the grade ten Honours course.

Sample

The subjects used were 191 boys enrolled in the grade ten Honours course at Brother Rice High School in St. John's, Newfoundland, during the school years 1974-1975, 1975-1976, 1976-1977. There was no selection procedure used; rather all students for whom data was available were included in the study.

Procedure

To answer the major purpose, a stepwise multiple regression was used which was developed by Draper and Smith (1966) and programmed for the IBM 360/370 computer by Carlson and Hazlett (1969) of the University of Alberta's Educational Research Services. The computations were performed at the Computer Services Department of Memorial University of

Newfoundland.

To answer the secondary purpose, an analysis of variance was performed using an F-test to determine significant differences. This was also done at the Computer Services division of Memorial University using a program written by Hunka and Bay (1969) of the University of Alberta's Educational Research Services.

Results and Conclusion

The grade nine mathematics mark was the single best predictor in seven of the eight groupings considered. Two of the multiple regression equations contained three variables, five contained two variables, and one equation contained only one variable. In all eight equations the grade nine mathematics mark was the factor that carried the largest b weight. The SRA Educability score appeared in five of the equations and the SRA Modern Mathematics score appeared in three equations. Multiple correlation coefficients were found ranging from 0.502 to 0.756 with a mean value of 0.657.

The difference in performance in the grade ten Honours course that could be attributed to the school that was attended prior to coming to Brother Rice High School was not significant at the .05 level.

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The writer wishes to thank Br. J. F. McHugh, Principal of Brother Rice High School, for allowing the study to be completed using the data from the school's permanent records. It is hoped that the results may be of some use to the school administration in their placement procedure.

The writer also wishes to acknowledge the contribution made to this thesis by Dr. R. D. Connelly who acted as supervisor of the project, by Dr. G. K. Wooldridge who acted as the second internal examiner, and by Mr. G. Williams who acted as external examiner.

The writer dedicates this thesis to his wife and son from whom so much time has been taken during the past three years. This thesis is made with the pledge that the time will be more than made up during the years to come.

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CHAPTER 1

INTRODUCTION

Background of the Tri-Level Approach

As early as 1966, the Newfoundland Department of Education realized that the single level course in algebra and geometry was not adequate to meet the needs of all the students enrolled in the program. At that time a "General Course" was introduced using the A.S.T.C. Mathematics Books I and II (1966). The mathematics of this "General Course" was supposed to be less theoretical, less abstract, and less rigorous. It was supposed to be more of a practical and applied mathematics, and was designed for students who were trade school bound and who would not need the "academic" mathematics for entrance to any other post secondary institution; it was also the mathematics for students who were going directly into the labor force.

This two-level approach continued until 1974, when the Newfoundland Department of Education introduced a third level called "Honours Mathematics." The designation of the different levels currently used in the Newfoundland schools is Basic, Matriculation, and Honours with the recommendation from the Newfoundland Department of Education that approximately 15 percent of the students be placed in Basic, 70 percent be placed in Matriculation, and 15 percent be placed in Honours.

The Basic course is for students entering trade school and other post secondary institutions which do not require a theoretical type of mathematics; and for students who plan to go directly into the labor force. The reason most students are placed in this course is because of prior difficulties with mathematics and because those responsible for making such educational decisions feel these students would have a better chance at success with the mathematics of this course than with the more theoretical Matriculation course.

The Matriculation course is designed for students who wish to enter university, technical college, or any other post secondary institution. It is the course that is recommended for the majority of the high school students (70 percent as stated previously). From the statistics published by the Newfoundland Department of Education, it seems that the course is easy enough to offer success to the great majority of students that take it, since 80 percent passed the course in 1976, the first year of its introduction. Also, from Williams' (1977) report, it seems the course is comprehensive enough to prepare students adequately for university, since 79 percent of the Matriculation graduates passed the December examinations of the first year mathematics course at Memorial University of Newfoundland. From the statistics mentioned above, it seems that the mathematics that is offered by the Matriculation course is adequate to meet the needs of the students taking it.

The Honours course is for that third group of students who are especially gifted in mathematics, who have a better than average interest in mathematics, and who may wish to proceed to higher education in mathematics or mathematically related fields. These students are capable of handling a more difficult mathematics than that offered by the Matriculation course and they should be given the opportunity to utilize these abilities at the high school level. Those students need something extra, not because it will help them get higher marks in first year university, but because such students should be given a challenge; they should be given something interesting to work at and think about. Some of these students may leave high school without ever having had to do much mathematical thinking at all. The Honours course is a rigorous approach to mathematics containing many of the topics covered in first year courses at Memorial University of Newfoundland (for a more thorough description, see Appendix A) and is designed to meet the mathematical needs of the top 15 percent of the student population.

With three levels or streams of mathematics in our Newfoundland schools, the correct placement of a student in the stream for which he is most suited becomes an important and difficult task. It is the task of placing students in the grade ten Honours course at Brother Rice High School in St. John's, Newfoundland to which this thesis addresses itself.

Statement of Problem

Brother Rice High School students come from three different schools. St. Bonaventure's College and Holy Cross Elementary both go up to and include grade nine; St. Patrick's Junior High only goes to grade eight with their students coming to Brother Rice High School for grade nine. Consequently, in the grade ten Honours course, there are students who did grade nine at St. Bonaventure's College, Holy Cross Elementary, and Brother Rice High School. Some of these students did Honours mathematics in grade nine and some did not; unfortunately this information is not retrievable from the cumulative records of most students, since the Honours mathematics designation was not used on the school report forms until this year. Consequently, this information has not been used for placement purposes and should not affect this study since the factors used for placement are the same as the ones used for this study.

Out of approximately 300 students who enter Brother Rice each year, there are about 75 students placed in two Honours classes. However, the rate of success of these students has been far from overwhelming, despite fairly careful screening techniques. About half of these students score below a grade mark of 75 percent, are not permitted to continue in the Honours program, and are placed in the Matriculation course in grade eleven. The rationale for dropping these students is that it is felt that they would have to struggle with the grade eleven course and this may hinder their performance on their other subjects. This, plus the fact that it is doubtful if a student who scores less than 75 percent is truly an "Honours" student, led to the decision to have only one class of Honours mathematics in grade eleven this year (approximately 35 students or 15 percent of the grade eleven population). In the report quoted earlier in this paper, Williams (1977) says:

> . . . only 15% of our Mathematics students in High School wrote the Honours examination in June, 1976. I believe this number should be at least doubled. There are too many good students in this province not doing the Mathematics they are capable of doing. (p. 9)

The problem then is how to identify these "good" students referred to in the article above. That is, how well is it possible to predict what a student will do in the grade ten Honours mathematics course? If this prediction can not be made, then the point made in the article may be invalid. What the article seems to imply is that since

Honours students do better at university, therefore there should be more Honours students. But if more students do not have the ability to handle the Honours course, and if this ability is not recognizable, then how can there be more students placed in the course?

The major purpose of this investigation was to determine the predictive efficiency of the Science Research Associates High School Placement Test Educability score, Reading score, Modern Mathematics score, as well as the predictive efficiency of the grade nine mathematics mark received by the students from each of the three schools previously described. This was done by means of zero order correlations between each of the six independent variables referred to above and the dependent variable of the Honours mathematics mark received in grade ten. Then by means of a step-wise multiple regression analysis, the best possible prediction equations were determined separately for each group of students from each of the three schools. This was done first using data from the 1976-1977 school year only, and then for the pooled data from the three school years 1974-1975, 1975-1976, and 1976-1977. In addition, the data for all three groups was pooled and again the best prediction equations for the entire population of grade ten Honours mathematics students was obtained first for the school year 1976-1977 and then for the pooled data from the three years 1974-1975, 1975-1976, and 1976-1977. This gave a total of eight regression equations which were analysed to determine which were the best ones to use.

A secondary purpose of the investigation was to determine if there was any significant difference between the students from the three schools in their academic achievement in the grade ten Honours mathematics course. This was done by calculating the means of the final marks obtained by each of the three groups in the Honours course in grade ten and applying an F-test to see if the means were significantly different statistically. This was done in two steps, first using the data from the school year 1976-1977 and then using the pooled data from the school years 1974-1975, 1975-1976, 1976-1977.

Specifically, this investigation sought to answer the following questions:

1. What were the means and standard deviations of all variables and especially of the criterion?
2. Were the means of the criterion significantly different for the three groups?
3. What were the zero order correlations between each of the predictors and the criterion?
4. What were the contributions of the predictors to the variance of the criterion?
5. What were the multiple correlations between the predictors composite and the criterion?
6. What were the best multiple regression equations?

Definition of Terms

The following terms require precise definitions in this study:

SRA High School Placement Test. The SRA High School Placement Test is a placement and guidance instrument designed to yield objective and standard test information on all students entering a given high school. It is designed to measure the scholastic achievement of entering ninth- and tenth-grade students and their potential for academic success.

Academic achievement. In this study, academic achievement refers to performance in grade ten Honours mathematics as measured by the school grades written on the pupils' permanent records at the end of the year.

Final tenth grade mark. The final tenth grade mark is the teacher assigned final mark received by the student at the end of grade ten.

Prediction. Prediction refers to the estimate of the final tenth grade marks which will be made from the relationship found to exist between the predictors and the criterion.

Predictor. Predictor designates a variable, the measurement of which at a certain point of time is used to predict performance on some other variable at some other future point of time. The predictor variables in this study were the SRA High School Placement Test Educability score, ~~Reading score~~, Modern Mathematics score, Composite score, Science Methodology score, and Ninth-Grade Mathematics score.

Ninth-grade mathematics score. The ninth-grade mathematics score is the final mark received by the student as recorded on his permanent record. In the case of a school which reports algebra and geometry as separate marks, the ninth-grade mathematics score is the average of the two of them.

Criterion. The term criterion refers to the variable to be predicted. In this study it refers to academic achievement in the grade ten Honours mathematics course.

Zero-order correlation. A zero-order correlation represents the degree of relationship that exists between two variables within a given sample. All zero-order correlations in this study were computed as product-moment correlations.

Multiple correlation. Multiple correlation indicates the degree of relationship that exists between a composite variate of two or more predictors or independent variables and the criterion or dependent variable.

Multiple regression equation. A multiple regression equation refers to an equation developed through statistical analysis of the scores of the participating subjects in a particular setting on two or more predictor variables and a criterion variable. The equation is used for predicting the unknown criterion score of a new subject from his known set of predictor scores.

Partial regression coefficient. A partial regression coefficient represents the value of the "b" weight in the regression equation of the form $y = b_o + b_1x_1 + b_2x_2 + . . . + b_nx_n$. It ensures the maximum correlation between a predicted and a corresponding obtained value.

Rationale of the Study

The particular investigation of this thesis originated from the practical problem of placement of students. Students entering Brother Rice High School have three choices available to them as to their mathematics program. The decision as to which students are placed in which stream, Basic, Matriculation, or Honours, is one which may have grave consequences to the life of the student. Consequently, the best and most accurate method of predicting the academic success of students should be employed. Add to this the fact that 50 percent of the students who were placed in the grade ten Honours mathematics course scored below a grade mark of 75 percent on the year's evaluation, and were not permitted to continue with the Honours course in grade eleven, and one can see the obvious need to reassess the placement procedure. It was with the view of improving the accuracy of the prediction of success in the grade ten Honours mathematics course at Brother Rice High School that this study was undertaken.

The problem of predicting academic achievement in secondary schools has received much attention in educational research. A great amount of time and energy has been devoted to improving prediction of academic success and a great number of studies have been published. These studies probably represent only a small fraction of those that have been conducted. If such a large number have been conducted, why then is it necessary to have another replication of basically the same work? The answer is that there are marked differences among institutions and each presents a totally different prediction problem. Many prediction studies on the secondary and higher level of education indicated that each institution represents a unique problem and must be treated as such. Carter (1947) supported this indication when he stated: "Prediction studies are validly applied only in the institution in which they are carried out (p. 34)." Johnson and Jackson (1959) have shown agreement with Carter's statement. Also, Crowley (1955) has indicated that there are differences in the abilities and in the ability patterns of students who are successful in different schools and in different school curricula. These differences would indicate that each school has a special problem in prediction and in selection.

Accepting the fact that this current study is a justifiable and necessary one, the next question that arises is how best to predict academic success. That is, what are the best predictors that may be used? Travers (1955) has pointed out that once high school is reached there is evidence that a student's grade in a particular subject matter field can be best predicted from his previous grades in the same or related fields. It seems that relative performance in the same subject is quite stable from year to year, so that ninth-grade scores are in general about as good as tenth- and eleventh-grade scores in the same subject. Cronbach (1970) says: "In academic prediction, previous school marks play an important part, since they invariably correlate well with success at the next level of education (p. 427)."

In addition to previous school marks, standard tests have been widely used as single and multiple predictors of high school and college success. For example, the studies of Howlett (1969), Morgan (1970), Koba (1974), and Strahler (1972) reported on in the literature review, all use standard tests scores as predictor variables. Standard tests are designed for easy economical administration and scoring and lend themselves to an efficient testing and guidance program. Furthermore, they provide an objective source of data for differential predictive studies. It is important to note that the authors of the SRA High School Placement Test Interpretive Manual (1968) emphasize the need for local research. They say: "Since the needs of particular schools or systems vary, the use of HSPT test scores should be adapted to individual requirements. This is best done by the development of local research studies (p. 15)." They go on to say:

> A third approach (to the local study) involves the somewhat more sophisticated procedure of obtaining a multiple-regression equation in order to get the best possible prediction of a future grade from all available predictor scores. (p. 16)

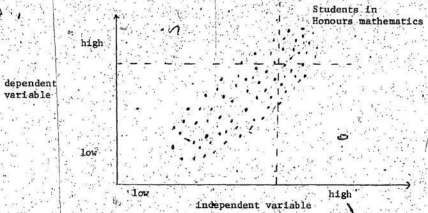
Limitations of the Study

This investigation was limited with respect to subjects, scope, and the procedures employed.

In regard to subjects, the study was limited to male students only who were enrolled in the Honours mathematics program in grade ten at Brother Rice High School in St. John's, Newfoundland during the school years 1974-1975, 1975-1976, 1976-1977. The sample represented all boys for whom data was available from the permanent records and was not a selected group from those enrolled in the Honours program. Consequently, the findings reported in this study were interpreted as being descriptive only of the population of boys in this particular high school. Similarly, the conclusions also have been applied only to the population described.

In regard to scope, the study was limited in both the criterion and the predictors. For the criterion, only academic achievement was used as a measure of the degree of success an individual subject had with the Honours program. No consideration was given to attitude changes, interests developed, or changed study and work habits. For the predictors, only the variables of SRA Educability score, Reading score, Modern Mathematics score, Composite score, Science Methodology score, and ninth grade mathematics score were used. However, articles by Cathcart (1974), Shepps (1971), and others suggest that there are many other variables which might affect a student's mathematical achievement. Such "non-mathematical" measures as study habits, attitudes toward school, interests, personality traits, environment, and a variety of other factors, were not investigated.

Finally, in regard to procedure used, multiple correlation techniques and multiple regression equations were employed in order to determine the best selection and weighting of the predictor variables for maximum predictiveness. This basically involves fitting a series of straight lines through the given data, but because of the extreme nature of the data, at the high end of both the dependent and independent variable scales, the correlations were small and the fit difficult to make. This effect can be shown more dramatically by the following diagram:



The r value for the entire group looks quite high, say about .8 or .9, but if the upper right hand quadrant is inspected, that is, the high scores on both variables, then the r value looks as though it may be close to zero.

The computations for this study were performed by the Computer Services facilities at Memorial University of Newfoundland on the Newfoundland and Labrador Computer Services IBM 360/370 computer.

Because of the stated limitations of this study, conclusions were made concerning the prediction of academic achievement only for the population of the particular high school represented in this study. No general conclusions concerning the prediction of academic achievement in the grade ten Honours mathematics course were warranted. Furthermore, recommendations were made, based on the conclusion of this study, for the selection and admission program at the high school where the study was undertaken.

CHAPTER 2

LITERATURE REVIEW

Streaming

Educational literature is filled with both opinion articles and research articles on streaming, ability grouping, tracking, etc. However, there seems to be no consensus of opinion as to its desirability or undesirability. For example, Hadermann (1976) writes:

> Ability grouping, streaming, tracking, homogeneous grouping, or phasing has been with us in the secondary school for generations. It is the rule rather than the exception in most medium-sized or larger secondary schools, in spite of the fact that research finds ability grouping to be an unsound practice. (p. 85)

In a similar negative vein, Sykes (1974) writes: "Of all the barriers ever placed in front of learners, none has been so obstructive as the practice of ability grouping (p. 29)." Sykes (1974) further goes on to say:

> Ability grouping is de facto dehumanization. Isn't it time we tried something else? We have built a society of second class scholastic citizens. We have molded a sub-culture of intellectual snobs. We have as James Thurber so aptly described it, grown accustomed to mistaking the container for the thing contained. (p. 34)

It is only in recent years that the Newfoundland mathematics program has introduced streaming in its high school courses. Why then was this done if all indications are that streaming is not an educationally sound practice? The answer is quite obvious. Despite what some authors say, there is a good side to streaming, for if there is not then why do so many schools practice it as indicated by Hadermann in the article quoted previously? The answer is not too difficult to find and can be summarized in the phrase, meeting the students' needs. An elaborate description of this is given by Rogers (1976) who writes:

> Students in every school fall roughly into five categories according to their ability level and into six categories according to their life needs. The categories based on ability include the mentally handicapped, the educationally disadvantaged, the students with average ability, those with above average ability, and the mentally gifted. The categories based on their life needs coincide with those based on their ability with the exception of the students in the average ability category. There are two distinct groups in this category. They are the work bound students and the preparatory students. The secondary school has an obligation to offer a program which will meet the needs of the students in these different categories. (p. 217)

In a similar fashion, Pieters (1961), writing about the Advanced Placement Program, says:

> This country has been faced for some time with the important responsibility of developing more effectively the potentialities of students who have capabilities and interests in mathematics. More specifically, our country's immediate problem is one of spotting these students, showing them what mathematics really is, helping them to develop interest in mathematics, and giving them a program that will be effective in producing the competence desired. (p. 201)

What then is the best course to follow? Streaming obviously has advantages and disadvantages, and some of these will now be discussed in more detail. The discussion is based upon expository writings and research findings of different people.

Probably the greatest disadvantage perceived in streaming is the negative effect it has on pupils in the "low ability" groups. These pupils become designated as second class citizens by both their fellow students and the teachers. Teachers (not all, but quite a few) see "general" classes as trying to their patience and an exercise in futility. This attitude is obviously picked up by the students, who in turn become discipline problems, refuse to learn, and just "exist" in class. Despite the intent, the students' needs are not being met, they become bored, and quite often drop out. Also, for whatever reason, students in the low ability class invariably come from the lower socio-economic class of society; thus the school further perpetuates segregation of our society into upper, middle, and lower class citizens. One further disadvantage of the low ability group is that teachers expect less from them than they are quite often capable of doing. Teachers move less quickly and quite often give up certain topics because their class will never understand it. Pupil motivation thus quickly dies, followed by disinterest, boredom, and discipline problems.

However, looking at the other side of the coin, are these students to be placed in a program that they obviously can not handle, a program that will cause them nothing but frustration because they are the only ones who can not cope with it? Is everybody to be thrown into the same program where the slow student gets turned off just as effectively as when he was streamed? What the exact answer is may never be found, but attitudes toward different streams have to change if any success with streaming is to be found.

A possible answer to streaming is that of individualized instruction, which, although it has much to offer, is far from the panacea of all educational ills. Although it is beyond the scope of this thesis to discuss individualized instruction in any detail, a few of its inherent difficulties should be noted less the reader get the impression that it is the answer to streaming. First, the student is on his own for a fair amount of the time, and this requires a good deal of self motivation, a trait that is quite obviously not present in all students, indeed, not present in all adults. Second, it is the materials that must teach, and with the pitfalls of programmed instruction, it is no easy task to find such suitable materials. Third, since the student learns on his own from the materials, his reading ability will greatly affect his success. Finally, the teacher ends up teaching the same concept to all the members of the class, but at different times, not exactly an efficient use of teacher time.

Of all the arguments against streaming, the most severe and damning of all, and indeed the most shocking if it is true, is that expressed by Hadermann (1976) who says:

> The consciences of all are satisfied by ability grouping because it provides a balm for our failures. The pupils who do not learn, those who cannot read or figure, are assigned to classes in which they are not expected to learn, or read, or to figure. Our failure to teach them can be explained by the group to which they belong. It is not our fault. Grouping justifies our failure to deal with pupils as persons. (p. 88)

If this assertion is true, then education is in a very sad state, one which will take a lot more than throwing out streaming to improve it to any acceptable level.

The biggest single advantage that streaming has in its favour is that it is at least an attempt to cater to the needs of the students. Since students have different needs, they are obviously placed in different levels or programs. Rogers (1976) describes such levels quite well when she describes the Christian County High School program. She says:

> Level One is the most advanced level. It prepares the student for college in the area in which they plan to major,

> especially if they plan to enter the professions. The purpose of this level is to meet the needs of the above average students and the mentally gifted.
>
> Level Two is the level of average difficulty and corresponds to the standard level of difficulty at which most subjects are taught in schools without a levels program. There are two distinct curriculums under level two. One is oriented to the world of work and meets the needs of the work-bound students. The other curriculum meets the needs of the preparatory students by preparing them for further formal education or training beyond high school, such as nursing schools, etc. It also prepares them for college work except in the area in which they plan to major.
>
> Level Three, the basic level, is the easiest level. There are also two distinct curriculums under this level. One meets the needs of the mentally handicapped and one the needs of the educationally disadvantaged. Difficulty of subject matter and materials used are the differentiating factors. The curriculum of both groups is slanted toward the vocational life needs of these students. (p. 218)

Surely the people who designed such an elaborate curriculum are not simply trying to "satisfy their consciences" as was suggested by Hadermann. Surely these educators had the best interests of the students at heart.

Rogers (1976) also does an excellent job when she summarizes the philosophy of the levels program. She says:

> The basic philosophy upon which the levels program is built is that it is the schools responsibility to meet the needs of each individual student, taking him where he is and helping him develop as far as he can and desires to go. It also includes the belief that each student and his parents should be given the freedom to choose the level on which the student works. (p. 219)

One very important point must be noted about such a levels program, and it is that it must be flexible enough to allow students to change levels. The choice of the level must be made by the student (and his parents) based on the recommendation of teachers, counselors, and other educators. However, after a week or a year in any level, the mechanism must be there to allow the student to change levels, either up or down. The system must not lock students into a level once they are placed there.

To discuss streaming, and in particular streaming in mathematics, without some mention of the Advanced Placement Program in mathematics currently in use in the United States, would be an oversight indeed. There were many background events that led up to the Advanced Placement Program but probably the two most notable were the study on "General Education in School and College" conducted by Blackmer and the study on "School and College Study of Admission with Advanced Standing" directed by Chalmers. In his paper, Pieters (1961) reports on both of these studies. He says:

> Mr. Blackmer's study was concerned with the great deal of evidence showing that many brilliant boys were bored either in first year college through repetition of material which they had already adequately covered in school, or were bored in the later years of their school work by repeating material which they had already assimilated but which their slower classmates had not mastered at the first attempt.
>
> The basic assumptions under which President Chalmers' group worked were:
>
> 1. The able student is wasting a lot of time in school.
> 2. The best place for a school boy or girl is in school.
> 3. The best teachers of boys and girls of this age are usually found in secondary schools. (p. 202)

The natural result of these studies was the feeling that more opportunity should be provided for those able students, but it should be provided in the local school rather than by sending these youngsters to college at an early age. To provide this opportunity a program was outlined which was the equivalent of one year of college work, and which would be completed in the high school. Of course, agreement by different colleges on such a program was extremely difficult to secure. The fact that any agreement was possible is undoubtedly due to the fact that many men realized the grave nature of the situation required cooperation of all those concerned. In Newfoundland, we are more fortunate in that we have only one university to contend with, yet to the best of the writer's knowledge, no attempt has been made to introduce any course similar to the Advance Placement Program. On the contrary, the university has considered making the Honours course the basic course for university entrance, and requiring Matriculation students to do an extra course to make up the difference. Probably, they should be saying that the Matriculation course is the course for university entrance, and offering the schools the option of teaching the first year university course as the Honours program in grade eleven. The university could set the examinations, prescribe the curriculum, and give the students a credit for their work. This would then be Newfoundland's version of the Advanced Placement Program. It seems that the colleges in the United States are more than willing to be involved in such a program. This is apparent from what Pieters (1961) says:

> Most colleges and universities welcome advanced placement students in mathematics. Many give both credit and advanced placement. The colleges are doing this for two main reasons. They are aware of the high standard set by the program and are reasonably confident of the student's knowledge. Also, the colleges wish to encourage secondary schools and capable students at this level by recognizing publicly the college mathematics taught in the secondary schools. Faith in competent secondary school teachers today is most important, especially when demonstrated by college admissions officers, registrars, and professors. (p. 205)

To group or not to group is still a big question. Newfoundland has decided on grouping and the effects will not be fully appreciated for years to come. However, as was noted, ability grouping has both good and bad points, the essence of which is summed up quite nicely by Schrank (1969) who writes:

> The implications for educational practice of these findings are that ability grouping for the purpose of providing academic stimulation for superior students is a waste of time. However, grouping for the means of applying a differentiated curriculum to fit the needs of the individual students is both worthwhile and desirable. (p. 415)

Predictive Studies

The decision to place a student in a particular stream or level is obviously based on information about the student which would lead the educators involved to believe that the student has the ability to handle the material in the course and to achieve a moderate degree of success with it. If a student is not challenged by the course, or if, despite hard work, is unable to succeed, he has obviously been misplaced in the program. Since the Honours program is purposely designed to challenge students, the placement procedures used must be the best possible available. Using the particular procedure a student's success should be predictable with at least a moderate degree of accuracy. Consequently, most placement procedures are based on prediction of success and quite often involve multiple regression equations. There are many examples of the use of multiple regression for predicting academic achievement in general and mathematics achievement in particular, and some of these are described in this section.

Shaw (1956) conducted a study using 387 subjects in Sewanhaka High School in Nassau County, New York. As predictors he used the Iowa Algebra Aptitude Test, the Otis QS Mental Ability Test, and the Iowa Silent Reading Test. The criterion for the study was success with the elementary algebra course as measured by the departmental final examination devised by the school's mathematics department, and the Lankton

First Year Algebra Test. However, because of its objectivity, only the Lankton test was used in the final summary. The zero order correlations between the factors and the criterion ranged from 0.45 for the Iowa Reading Test to 0.54 for the Iowa Algebra Aptitude Test. The interesting thing about this study is that the predictors did not involve achievement but aptitude and ability tests.

Barnes and Asher (1962) did a study to see how to best select students for the first-year algebra course in grade nine. As predictors they used such variables as previous grades, achievement test results, IQ test results, and algebra prognostic test results. They used a total of ten variables in all on a sample of 192 students from two junior high schools in the same community. The highest zero order correlation was 0.588 between the eighth-grade mathematics mark and success in ninth-grade algebra. Despite the large number of predictors the maximum computed multiple correlation was 0.661 which means that only 44 percent of the variance could be accounted for using all ten variables.

In a study conducted by Holland and Astin (1962), a total of 54 different variables were investigated as possible sources of prediction of academic achievement. The main point of the study is summarized quite well by the authors when they say: "This crude ordering implies that for purposes of prediction we could abandon our efforts to construct sophisticated inventories, and instead, concentrate on securing more elaborate records of past achievement (p. 143)."

Ingersoll (1966) investigated the use of the General Aptitude Test Battery for identification and counseling of students in vocational and academic classes in Ohio secondary schools. Frequency distributions of the GATB aptitude scores were developed for 4,000 ninth- and tenth-grade boys and girls. A multiple regression analysis was performed using the aptitude scores of the GATB as the independent variables, and point hour ratio and single subject grades at the end of one year as the dependent variables. It was found that the GATB was useful in the predictive role for ninth- and tenth-grade achievement in most of the areas studied, with the regression analysis yielding multiple correlations for mathematics ranging from 0.462 to 0.550.

Strowig (1970) does a comparison of two studies in which the utility of two non-intellective variables, self-expectations and self concept of ability, as predictors of scholastic achievement was examined. Because of its established predictive potential, academic aptitude was included as an independent variable in the multiple regression equations. The results of the comparison show that no significant difference existed in the multiple correlation coefficients of the two female high school student samples, but a significant difference was found in the coefficients of the two male samples. The multiple correlations obtained in one study were 0.76 for boys and 0.73 for girls. The addition of the non-intellective variables made a sizeable gain in explaining variance in scholastic achievement over what would have been found using only the academic aptitude variables.

Guiler (1944) conducted a study on 75 pupils enrolled in the ninth grade in the public schools of Marion, Ohio. As predictive variables for success in elementary algebra he used the Iowa Algebra Aptitude Test, the Christofferson-Rush-Guiler Analytical Survey Test in Computational Arithmetic, and Form A of the Breslich Algebra Survey Test. He found a multiple correlation of 0.775. It is important to note that even at this fairly early date in predictive studies, the investigator realized the importance of other variables than achievement and aptitude for he says:

> The fact that some of the pupils did not actualize their potential achievement indicates that there are factors besides native capacity and related background training which influence achievement. Hence, it seems reasonable to assume that the forecasting efficiency achieved in this study might have been increased if items such as study habits, pupil motivation, teacher personality and skill, home and school relationships, and the like had been included in the list of predictive criteria. (p. 32)

This suggestion is at complete odds with that made by Holland and Astin (1962) who suggested that such variables should be abandoned and a concentration be made on collecting more elaborate data on achievement. Which view is correct is still a matter of contention, and it is not the purpose of this investigation to try to resolve that contention. This study simply uses the predictors that are available on the student records, which happen to contain achievement data and standardized test data.

Hall (1971) conducted a study to determine the predictive value of: (1) selected data which are available at the conclusion of the seventh grade, (2) selected data which are available at the conclusion of the eighth grade, and (3) selected data which are available at the conclusion of the ninth grade in a large number of schools relative to a student's future success in each of six four-year selection of secondary mathematics, and to develop multiple regression equations at each of the three specific times that would enable one to predict the student's score on the criterion. He found that all predictor variables, except one, correlated positively and significantly beyond the .01 level with the criterion. Twenty predictor variables correlated above 0.500

with the criterion. The multiple correlations of 0.871, 0.929, and 0.963 were the highest reported by any study the investigator was able to find.

Strahler (1972) attempted to determine from certain available data, factors that best predicted success in ninth-grade science and mathematics courses. The subjects used were 324 selected pupils in four schools of Dayton, Ohio. The predictive factors used were those available on permanent record cards of the pupils in the 1971 graduating classes. The factors considered were teachers' marks or grade point average (GPA) in eighth-grade science, English, and mathematics; scores on the California Achievement Test (junior high level) or the Stanford Achievement Test--Partial Battery in language, reading, and arithmetic; and the California Short Form Test of Mental Maturity (level 3) language and nonlanguage scores. The criteria used were the GPA's given by teachers of ninth-grade science and mathematics to the subjects of this investigation.

Strahler concluded that all factors studied accounted for some variability and could be used as predictors of success in ninth-grade science and mathematics. Seven variables gave the highest multiple correlation coefficient. However, there was so little difference in the last four multiple coefficients, which varied from 0.597 to 0.602, that it was concluded that the four variables with the highest multiple correlation was probably the best educationally significant one. These four factors were English eight GPA, reading achievement, science eight GPA, and nonlanguage mental maturity. Only 36 percent of the variability of individuals in science was accounted for by the factors used.

Wilbur (1973) did a study to form linear multiple and joint multiple regression equations and test hypotheses to see if the equations would predict academic success in a course in intermediate algebra. The study involved collecting data on sixteen variables from students' permanent records in three large high schools in Kansas. The sixteen variables used in the study were: (1) sex of the student; (2) the grade level in the school where the course was taken; (3) the grade in geometry; (4) the grade in elementary algebra; (5) the grade point average (GPA) for mathematics courses taken in grades seven, eight, nine, and ten; (6) the overall GPA in grades seven through ten; (7) the occupation of one of the parents; (8-15) the eight scores on the Differential Aptitude Tests (DAT) excluding the Clerical Speed and Accuracy score; (16) the grade in intermediate algebra.

Wilbur concluded that prediction equations can be developed, using the variables indicated, to predict success in intermediate algebra. However, the difference between the amount of variance accounted for by the linear and joint multiple regression equations was very slight in all groups. The best predictors of intermediate algebra grades were found to be the students' grades in plane geometry which had a zero order correlation of 0.734, the students' overall GPA with a zero order correlation of 0.731, and the students' grades in elementary algebra with a zero order correlation of 0.731.

Johnson (1972) did a study which was to determine through regression analysis the set of variables which most accurately predicted ninth-grade algebra and tenth-grade geometry grade point average (GPA). Variables included as predictors were first and second semester grades in eighth-grade mathematics; results of subtests in reading comprehension and vocabulary, arithmetic fundamentals and reasoning, and language mechanics and spelling taken from the California Achievement Test (CAT);

and language and nonlanguage raw scores as measured by the California Test of Mental Maturity (CTMM). These factors were obtained from students of Simi Valley Unified School District, Simi, California. In addition, grades for first and second semester algebra were included as predictors in the regression analysis for geometry.

For the full model regression on algebra GPA for the total set of students in the sample, only three partial correlation coefficients were significantly different from zero. These coefficients were for the first and second semester eighth-grade mathematics GPA and the CAT raw score in arithmetic fundamentals. Only 24.8 percent of the variance in the criterion could be considered as due to variance in the total combination of all independent variables. Similarly, for the full model regression on geometry GPA for the total set of students in the sample, only three factors gave partial correlation coefficients that were different from zero. These factors were second semester eighth-grade mathematics GPA and first and second semester algebra GPA. Again only 33.3 percent of the variance in achieved geometry grades was due to variance in the total combination of all independent variables.

Koba (1974) conducted a study to determine the validity of the SRA High School Placement Test Reading score, Arithmetic Computation scores, and Language Arts score in predicting academic achievement in ninth-grade algebra, Latin, and world history. The study was conducted using 692 ninth-grade girls enrolled in a Catholic high school for girls in northern New Jersey over the periods from 1961 to 1963 and 1968 to 1970. She found the SRA Reading score exhibited correlations with algebra grades in the magnitudes ranging from 0.20 to 0.60 with a median of 0.43. The Arithmetic Computation score indicated correlations with algebra grades in coefficients ranging from 0.36 to 0.68 with a median of 0.59. The Language Arts scores yielded correlations with algebra grades in coefficients ranging from 0.23 to 0.62 with a median of 0.43. The best single predictor of success in algebra in the school system studied was found to be the Arithmetic Computation score.

When all three predictors were applied in the form of a multiple regression equation, the best multiple correlation coefficient (R) obtained was 0.75 for the 1963 group, and the poorest R was 0.39 for the 1969 group. With a multiple R of 0.75, only 56 percent of the variance can be accounted for and Koba recommends including other variables in future SRA High School Placement Test prognosis studies, such as standard aptitude tests. This, she notes, might yield more significant results for high school prediction of academic success. This very important point was taken into account for the investigation for this thesis and the variable of previous performance in the grade nine mathematics was taken into account.

Impellitteri (1967) also investigated the use of the Science Research Associates High School Placement Test scores as predictors of ninth-grade academic achievement as measured by school grades. The sample was composed of 3,194 boys who were enrolled in an academic curriculum at one of ten randomly selected Diocesan high schools in Philadelphia. A multiple regression analysis and a canonical correlation analysis were performed using the subtest scores as independent variables, and final ninth-grade average, grades in English, social studies, Latin, general science, and algebra as the dependent variables. It was found that the Composite score of the SRA High School Placement Test individually would have been as useful a predictor of final grades as either of the empirically determined predictor composites computed in the multiple regression analysis which yielded multiple correlation coefficients ranging from 0.423 for the Latin criterion to a high of 0.543 for the overall average grade. The multiple correlation between a composite of the predictors (which were not given in the article) and the algebra grade was only 0.471 which accounted for only 22.2 percent of the total variance of the algebra grade.

Howlett (1969) did a study of placement methods for entering college freshmen in the proper mathematics sequence at Michigan Technological University. In his study on 1,000 entering students he used fourteen different variables. These were: X_1 - Michigan Technological University Advanced Mathematics Placement Exam, X_2 - Cooperative Algebra Test, X_3 - Cooperative Trigonometry Test, X_4 - Cooperative Reading Score, X_5 - ACT English Score, X_6 - ACT Mathematics Score, X_7 - ACT Composite Score, X_8 - SAT Verbal Score, X_9 - SAT Mathematics Score, X_{10} - Sum of SAT Mathematics and SAT Verbal Scores, X_{11} - National Merit English Score, X_{12} - National Merit Mathematics Score, X_{13} - National Merit Selective Score, X_{14} - Class Rank. However, all the data was not common to all the students and so he divided them into three groups or phases. Phase I included variables X_2, X_3, X_{14}, as well as X_5, X_6, and X_7 for a total number of test cases of 497. Phase II added variables X_8, X_9, and X_{10} for a total number of test cases of 147. Phase III contained the scores common to all three phases plus variables X_{11}, X_{12}, and X_{13} for 197 test cases. The basic design of the study was to develop a multiple regression equation using the various combinations of the independent variables. The procedure was set up so as to give back the intercorrelations of all variables and the multiple correlation values of each of the combinations used. The data was analysed by a computer program which was written to give the best possible prediction combinations. The program was designed to eliminate the predictors according to the amount of weight each carried in relation to the other predictors. Thus a stepwise elimination procedure did away with the need of computing all possible combinations in the regression analysis. The regression formulae thus established for each phase were as follows, where y is the predicted value of the dependent variable:

$$y = .004102X_{14} + .136556X_{12} - 4.912763$$

$$y = .090805X_6 + .002833X_{14} - 2.933113$$

$$y = .00307X_9 + .002586X_{14} - 2.057255$$

Having established the regression formulae, it was then necessary to establish a suitable cutoff point to determine entrance into the program, that is, what value of y would a student need to assure him, within a certain confidence interval, of at least a C grade in the course. After further analysis a cutoff point of 1.5 was selected.

In his conclusion Howlett (1969) notes that the most difficult problem associated with prediction of achievement is that one can never really foresee the reasons why or how a person will act or perform in different environmental situations. This is an important point for the problem of this thesis, since the majority of the students are coming from the three different schools and will be at Brother Rice for the first time. There is no doubt that the change in atmosphere has a drastic effect on some of the students.

Also, Howlett (1969) notes that of primary concern is the fact that the correlation values obtained in the experiment, although significant, were not ideal. For example, the highest correlation coefficient was 0.404 between high school class rank and the analytical geometry grade. The next highest value was 0.394 between the Cooperative Algebra Test and the criterion. By combining all the variables using stepwise multiple regression techniques the optimum multiple correlation was found to be 0.589. Howlett's study was discussed at greater length because of the similarity of the procedure used by him and the investigator of this thesis. The method of stepwise multiple regression is a recent one that seems to offer several advantages which will be discussed in the section on procedure in the next chapter. One final study using a stepwise regression procedure will now be discussed before moving to the next section.

Wampler (1966) did a study on the prediction of academic achievement in college mathematics at the Nebraska Wesleyan University. The purpose of his study was to select several measures of aptitude which could be used to predict performance in college mathematics. The key difference with this study was that the variables under scrutiny were such things as personality factors, interests and attitudes, and special aptitudes as opposed to the usual variables of IQ and previous mathematical knowledge, that are used in most other studies. This is of particular significance to the proposal for this thesis since only the information that is available on the student record cards is being used and this does not include any information similar to that used in Wampler's study. The proposal is designed this way so as to be of maximum utility to the school administration who would not have access to any special test scores when making placement decisions. It is unfortunate that the administration does not have more information to go on, since most studies based on IQ and achievement test scores account for only about

50 percent of the total variance in the dependent variable. However, the time and cost factors are just too great to consider administering more tests.

The variables used by Wampler (1966) were: X_1 - Locations Test, X_2 - Addition Test, X_3 - Division Test, X_4 - Subtraction and Multiplication Test, X_5 - Mathematics Aptitude Test, X_6 - Necessary Arithmetic Operations Test, X_7 - Inference Test, X_8 - Wide Range Vocabulary Test, X_9 - Cube Comparison Test, X_{10} - Matched Problems V, X_{11} - Surface Development Test. His method of analysis was very similar to Howlett's and, hopefully, if the computer center at Memorial has the specific program, similar to that which will be used by this thesis. The method was to consider all possible linear combinations of the eleven independent variables and from this extract the most effective combination of any given number of variables. The final result was a table giving the best predictor combinations. Part of Wampler's table is reproduced here to show the type of thing expected from this study:

Variables	Multiple r	Partial r	Standard Error of Estimate
X_8	.8531	.8531	4.760
X_1X_8	.8946	.5169	4.183
$X_1X_4X_8$	.9206	-.487	3.754

From this data a regression equation for the best combination of any number of variables may be obtained.

CHAPTER 3

SUBJECTS, MATERIALS, AND PROCEDURE

Subjects

The sample of subjects used in this study consisted of a total of 190 tenth-grade boys enrolled in the Honours mathematics course at Brother Rice High School for the school years 1974-1975, 1975-1976, 1976-1977. The subjects were broken into eight groups according to the school from which they came and the year in which they did the Honours course. Because of the nature of the study the schools will be referred to as A, B, and C with the identity of the schools known only to the investigator, the thesis supervisor, and the principal and mathematics department head of the school involved. The eight groups were: (1) 27 boys from school A enrolled for the academic year 1976-1977; (1) 17 boys from school B enrolled for the academic year 1976-1977; (3) 27 boys from school C enrolled for the academic school year 1976-1977; (4) 71 boys which comprised the complete Honours classes at Brother Rice High School for the academic school year 1976-1977; (5) 92 boys from school A for the three-year period covered by the study; (6) 37 boys from school B for the three year period covered by the study; (7) 61 boys from school C for the three year period covered by the study; (8) 190 boys which comprised the complete Honours classes at Brother Rice High School for the three-year period covered by the study.

There was no random selection of subjects. All the subjects who were enrolled in the grade ten Honours mathematics course and on whom data were complete for the High School Placement Test scores, final ninth grade mathematics marks, and final tenth grade Honours mathematics marks, were included in the study. Those students for whom any part of the data was missing were excluded from the study.

The rationale for selecting and limiting the sample of subjects within the same school was that the study arose out of the very practical need of improving the placement procedure currently in use at that school as it applies to the Honours mathematics course. Furthermore, such factors as teaching methods, grading systems, and population characteristics, which may contribute to the variance of the criterion were thus eliminated from the study.

Materials

The materials used in this investigation were: (1) the Science Research Associates High School Placement Test, Series 74K, 75K, 76K--these forms were administered to the students from schools A and B while they were in grade nine and to the students from school C while they were in grade eight; (2) ninth-grade mathematics marks as they were recorded on the students' permanent records; (3) tenth grade Honours mathematics marks as they were recorded on the students' permanent records.

The Science Research Associates High School Placement Test Interpretive Manual (1968) says:

> The SRA High School Placement Test (HSPT) is designed to measure the educational ability and scholastic achievement of second-semester eighth-graders and first semester ninth-graders. The various scores have a wide application. They are used in placing students in appropriate curricula, in

> grouping them according to ability, in evaluating their achievement, in identifying the gifted and those needing remedial attention, and in selecting students for schools with special requirements or limited enrollment. (p. 1)

The HSPT subtests are separately timed. One measures educational ability; the others test achievement in reading, language arts, arithmetic or modern mathematics, social studies, and science methodology. In addition, there is a composite score. Only those subtests which were described in this study will be described in detail.

The Educational Ability subtest consists of 50 items, each with five alternative responses. There are four sections designed to measure abilities that are not dependent on specific course content: Word Reasoning, the ability to recognize word meanings (15 items); Arithmetic Reasoning, the ability to analyse and solve problems (10 items); Verbal Analogies, the ability to see the relations between words (15 items); and Number Reasoning, the ability to detect patterns in number series (10 items). The time for this subtest is 35 minutes.

The items for the Reading and Language Arts scores are based on the same reading passages, although it is only the Reading score that is of interest for this study. This subtest uses complete passages from both fiction and nonfiction to approximate real reading situations. There are 85 items, divided approximately evenly between Reading and Language Arts. The items that contribute to the Reading score are designed to measure the ability to grasp the theme of a passage, to understand the related ideas, to draw inferences, to perceive small detail in the passage, and to comprehend word meanings in context. The time for this subtest is 50 minutes.

The Modern Mathematics subtest consists of 38 items with four possible responses each. This subtest is supposed to measure concepts and skills common to most current modern mathematics programs and covers such content areas as: elements of mathematics, operations with numbers, and metric and nonmetric geometry. The time for this subtest is 30 minutes.

The Science Methodology subtest consists of 30 items with seven possible responses each. It is supposed to measure the student's ability to understand certain deductive experimental procedures and to identify them as elements of specific experiments. Time for this subtest is 20 minutes.

The composite score is an average of the Reading, Language Arts, and Modern Mathematics subtest scores.

The rationale for using the SRA High School Placement Test as opposed to some other standard test was simply the fact that it is the one currently being used by the school under study. Consequently, these scores were available from the students' permanent records. No thought was given to administering any new or different tests as it was hoped to make the study as practical and as useful as possible to the school administration and thus the investigator sought to work within the framework of data available to him.

In addition to the SRA High School Placement Test scores, the grade nine mathematics mark and the grade ten Honours mathematics mark, both of which were recorded on the student's permanent record, were also used in this study.

Procedure

The first type of analysis of the data was a multiple regression analysis. This type of analysis tries to fit a series of straight lines to the data so that an equation relating the criterion value, y, to the independent variables, x_i, may be found. Thus one develops an equation of the form: $y = b_o + b_1x_1 + b_2x_2 + \ldots + b_nx_n$, where the b_o is the constant term and each b_i is the "weight" contributed by the variable x_i. In most types of regression analysis, the variable with the greater correlation coefficient contributes most to the equation, but in a stepwise regression procedure used in this study this may not be so. Draper and Smith (1966) describe the procedure very accurately when they write:

> The improvements offered by this type of regression analysis involve the re-examination at every stage of the regression of the variables incorporated into the model in previous stages. A variable which may have been the best single variable to enter at an early stage may, at a later stage, be superfluous because of the relationships between it and other variables now in the regression. To check on this, the partial F criterion for each variable in the regression at any stage of calculation is evaluated and compared with a preselected percentage point of the appropriate F distribution. This provides a judgment on the contribution made by each variable as though it had been the most recent variable entered, irrespective of its actual point of entry into the model. Any variable which provides a nonsignificant contribution is removed from the model. This process is continued until no more variables will be admitted to the equation and no more are rejected. (p. 171)

The data were subjected to the stepwise multiple regression analysis using an IBM 360/370 Fortran IV program developed by Carlson and Hazlett (1969) based on the method of determinants as described by Draper and Smith (1966). The program was one from a package of programs purchased from the University of Alberta Division of Educational Research Services by the Newfoundland Labrador Computer Services.

The program gives the following information: means and standard deviations of all dependent and independent variables; zero order correlation coefficients between all variables, both independent and dependent;

the F-test value, probability level, and percent of variance of the criterion accounted for by the addition of each independent variable; an analysis of variance table for each step in the stepwise multiple regression procedure; the weight and standard error of the weight contributed by each variable; the constant term; and the standard error of the predicted y.

In addition to the multiple regression analysis, the criterion data were also subjected to a one-way analysis of variance with an F-test and a Scheffe multiple comparison of means to determine if the students from the three schools differed on their performance in the Honours mathematics course. This analysis was also performed on the IBM 360/370 computer using another program from the University of Alberta package written by Hunka and Bay (1969). Among the output listed by the program are: (1) mean, variance, and standard deviation of each group; (2) an analysis of variance table giving both the F-test value and the probability level; (3) the probability matrix for the Scheffe multiple comparison of means.

CHAPTER 4

ANALYSIS OF RESULTS

The purpose of this investigation was to determine the efficiency of the Science Research Associates High School Placement Test scores and the grade nine mathematics mark in predicting the final mark in the grade ten Honours mathematics course. This chapter presents the basic data on the interrelationships found among the variables under investigation and considers these data in relationship to the specific questions posed at the beginning of the study. The presentations of the findings were organized into eight sections corresponding to the eight groups described in Chapter Two in order to answer the problems associated with the primary purpose of finding regression equations. Also there are two other sections presenting the findings associated with the secondary purpose of determining if there was any difference between groups.

The SRA High School Placement Test scores are all given in percentiles while the grade nine mathematics mark is the raw score percentage from the cumulative records of the subjects. For the purpose of simplifying the tables and the discussion the variables are coded as follows: X_1 - SRA Educability score; X_2 - SRA Reading score; X_3 - SRA Modern Mathematics score; X_4 - SRA Composite score; X_5 - SRA Science Methodology score; X_6 - grade nine mathematics mark; X_7 - grade ten Honours mathematics mark, the criterion value.

Regression Analysis for School A Using 1976-1977 Data

The mean scores for the SRA subtests ranged from 77.3 for the Modern Mathematics to 85.3 for the Educability score. The greatest variance was in the Reading subtest which had a standard deviation of 19.5 and the least variance was in the Science Methodology subtest with a standard deviation of 12.5. The best correlation between a factor and the criterion was 0.714 between the grade nine mathematics mark and the grade ten Honours mathematics mark with the next best correlation being .512 between the criterion and the Modern Mathematics score. All these relations are shown more clearly in Table 1.

Table 1
Means, Standard Deviations, and Zero-Order Correlations for School A for 1976-1977 (N=27)

Factor	Mean	Standard Deviation	Correlation with Criterion (X_7)	Percent of Variance Accounted For
X_1	85.3	14.5	0.396*	15.6
X_2	77.3	19.5	0.182	3.3
X_3	77.5	15.7	0.512*	26.2
X_4	77.3	16.0	0.379*	14.3
X_5	82.7	12.5	0.373	13.9
X_6	84.4	6.8	0.714*	51.0
X_7	67.8	14.9	1.000	

*Significant value of r at the .05 level is 0.374.

Considering Table 1, it would be suspected that variables X_6 and X_3 would be the best two to use in a regression equation since they account for 51.0 percent and 26.2 percent, respectively, of the variance of the criterion X_7. However, this is not the case because there is a relatively high correlation of 0.435 between variables X_4 and X_3, and thus variable X_4 accounts for much of the variance of X_7 that would be attributed to X_3. Hence the use of X_3 becomes somewhat redundant. However, X_6 and X_1 have a correlation of only 0.217 and it is this variable, the third best correlation with the criterion that was found to be a better choice for the regression formula. The intercorrelations between all the variables can be seen from Table 2.

Table 2
Intercorrelations Among All Variables for School A for 1976-1977 Data (N=27)

	X_1	X_2	X_3	X_4	X_5	X_6	X_7
X_1	1.00	.616	.640	.760	.561	.217	.340
X_2		1.00	.640	.860	.358	.089	.182
X_3			1.00	.799	.423	.435	.512
X_4				1.00	.457	.321	.379
X_5					1.00	.37[illegible]	.373
X_6						1.00	.714
X_7							1.00

Significant value of r at the .05 level is 0.374.

An interesting point to note in Table 2 is that in all cases the correlations between the SRA scores (X_1, X_2, X_3, X_4, X_5) and the grade ten Honours mathematics marks (X_7) are greater than or equal to the correlations between the SRA scores and the grade nine mathematics marks.

This implies that the SRA scores for the subjects from school A are better predictors of what they will do in the grade ten Honours course than they are a description of what they have done in their grade nine mathematics.

One of the big advantages of a stepwise regression procedure, such as was used here, is that it enables the investigator to see clearly the contribution of each variable to the regression equation. Thus, for example, the equation using variables X_6 and X_1 account for 57.1 percent of the variance in the criterion, but the addition of variable X_3 only increases the percent of variance accounted for to 57.9 percent. However, rather than use an arbitrary cutoff point on the percent of variance for determining which variables would enter a regression equation, it was decided to include all variables whose correlation with the criterion was significant at the .05 level and whose b weight in the equation was significantly different from zero. Variables X_3 and X_4 satisfy the first condition (see Table 1, p. 40) but do not satisfy the second condition. X_3 has a weight of 0.122 with a standard error of 0.182 and X_4 has a weight of -0.212 with a standard error of 0.251. Consequently, the regression equation that was derived from the regression analysis is $y = 1.44X_6 + 0.260X_1 - 75.9$. A full description of the analysis is given in Table 3.

Regression Analysis for School B Using 1976-1977 Data

The mean scores for the SRA subtests ranged from a low of 83.9 on the Reading subtest to a high of 89.1 on the Science Methodology subtest. The greatest variance was a 14.6 standard deviation on the Reading

5.

Table 3
Best Predictive Combinations for School A
for 1976-1977 Data

Factors	Percent of Variance	Multiple R	Equation	Standard Error of y	Probability Level
X_6	51.0	.714	$y = 1.56X_6 - 63.8$	10.6	.0000
X_6X_1	57.1	.756	$y = 1.44X_6 + 0.26X_1 - 15.9$	10.2	.0000

subtest with the least variance being a standard deviation of 6.6 on the Science Methodology subtest. Just as it was for school A, the single best correlation was between the grade nine mathematics mark and the criterion. For school B this correlation was 0.640. However, the second best correlation in this case was not X_3, but X_1, which had a correlation of 0.579 with the criterion. These relationships are shown more clearly in Table 4.

Table 4
Means, Standard Deviations, and Zero-Order Correlations
for School B for 1976-1977 (N=17)

Factor	Mean	Standard Deviation	Correlation with Criterion (X_7)	Percent of Variance Accounted For
X_1	85.6	10.6	.579*	33.5
X_2	83.9	14.6	.249	6.2
X_3	85.6	13.1	.246	5.8
X_4	83.9	12.0	.291	8.5
X_5	89.1	6.6	.045	.2
X_6	84.3	7.7	.640*	41.0
X_7	61.6	13.6	1.000	

*Significant value of r at the .05 level is 0.468.

The important thing about this set of data is that the number of subjects is very small, N = 17, and thus a fairly large value of r is required for significance. The only two correlations that are significant at the .05 level are between the Educability score (X_1) and the criterion and between the grade nine mathematics mark and the criterion. Fortunately, these two variables do not have a significant intercorrelation and thus contribute different things to the regression equation. All the intercorrelations are shown in Table 5, and it can be seen that X_1 and X_6 have a correlation of 0.310, which is not significant at the .05 level.

Table 5
Intercorrelations Among All Variables for School B for 1976-1977 Data (N=17)

	X_1	X_2	X_3	X_4	X_5	X_6	X_7
X_1	1.00	.600	-.158	.419	.559	.310	.579
X_2		1.00	-.091	.691	.276	-.079	.249
X_3			1.00	.536	-.071	.567	.246
X_4				1.00	.094	.528	.292
X_5					1.00	-.030	.045
X_6						1.00	.640
X_7							1.00

Significant value of r at the .05 level is 0.468.

When the regression procedure was applied to the data the equation produced was $y = 0.90X_6 + 0.54X_1 - 60.53$. An important point to note is that the same two variables, X_1 and X_6, are again used in the regression formula. Table 6 has the full analysis for the variables with significant correlations. Both b weights are significantly different from zero.

Table 6
Best Predictive Combinations for School B
for 1976-1977 Data

Factors	Percent of Variance	Multiple R	Equation	Standard Error of y	Probability Level
X_6	40.9	.640	$y = 1.13X_6 - 33.7$	10.8	.005
X_6X_1	56.9	.754	$y = 0.90X_6 + 0.54X_1 - 60.5$	9.6	.002

Regression Analysis for School C Using
1976-1977 Data

The mean scores for the SRA subtests looked considerably lower for school C than for the other two schools. However, no attempt was made to analyse this difference because the students from school C wrote the SRA High School Placement Test in grade eight, whereas the other two schools wrote it in grade nine. The lowest mean score was 66.4 in the Reading subtest and the highest was 84.4 in the Educability subtest. The greatest variance was in the Modern Mathematics subtest with a standard deviation of 24.7 and the least variance was in the Science Methodology with a standard deviation of 13.9. Again the single best correlation between a factor and the criterion was 0.685 between the grade nine mathematics score and the criterion. The second best factor for prediction purposes was the Modern Mathematics score which had a correlation of 0.423 with the criterion. These relations are shown more clearly in Table 7.

Table 7
Means, Standard Deviations, and Zero-Order Correlations
for School C for 1976-1977 (N=27)

Factor	Mean	Standard Deviation	Correlation with Criterion (X_7)	Percent of Variance Accounted For
X_1	84.4	18.2	.368	13.5
X_2	66.4	22.4	.163	2.6
X_3	69.6	24.7	.423*	17.9
X_4	68.4	21.8	.215	4.6
X_5	70.3	13.9	.312	9.7
X_6	85.4	6.4	.685*	46.9
X_7	70.2	13.1	1.000	

*Significant value of r at the .05 level is 0.374.

From the data it can be seen that only two variables, X_3 and X_6, have a correlation with the criterion which is significant at the .05 level. Variable X_1 is also fairly highly correlated with the criterion but just fails to meet the .05 level of significance. The intercorrelation between variables X_3 and X_4 is 0.419 which is significant at the .05 level and hence much of the variance which would be described by X_3 will have been already taken care of by X_6. The other intercorrelations can be seen from Table 8.

When the regression analysis was applied to the variables and those whose contribution was not significant at the .05 level were removed, the resulting regression equation was $y = 1.27X_6 + 0.09X_3 - 44.7$. The full details of the analysis is shown in Table 9. It is important to note that the two schools which wrote the SRA test in grade nine had variables X_6 and X_1 in the equations, whereas school C which wrote the

Table 8
Intercorrelations Among All Variables for School C
for 1976-1977 Data (N=27)

	X_1	X_2	X_3	X_4	X_5	X_6	X_7
X_1	1.00	.398	.604	.663	.381	.365	.368
X_2		1.00	.493	.796	.197	.164	.163
X_3			1.00	.790	.353	.419	.423
X_4				1.00	.327	.249	.215
X_5					1.00	.285	.312
X_6						1.00	.685
X_7							1.00

Significant value of r at the .05 level is 0.374.

Table 9
Best Predictive Combinations for School C
for 1976-1977 Data

Factors	Percent of Variance	Multiple R	Equation	Standard Error of y	Probability Level
X_6	46.9	.685	$y = 1.42X_6 - 50.7$	9.8	.00008
X_6X_3	49.1	.701	$y = 1.27X_6 + 0.09X_3 - 44.7$	9.8	.00030

SRA test in grade eight has variables X_6 and X_3 in the equation. This same thing occurs when the data for the three year period covered by the study is analysed. Both b weights are significantly different from zero.

Regression Analysis for Complete Honours Classes 1976-1977 Data

The data for this section is simply the pooled data from the three groups previously described; 27 from school A, 17 from school B, and 27 from school C, for a total of 71 observations. The data was pooled in an attempt to check if the larger number of observations would give any better predictive power. However, what was gained by the larger number of observations, was probably lost by the addition of another source of variance, viz. the student's previous school, that was now not being considered.

The highest mean score for the SRA subtests was 85.0 in the Educability subtest and the lowest mean score was 74.7 in the Reading subtest. The greatest variance was in the Reading subtest which had a standard deviation of 20.6 and the least variance was in the Science Methodology subtest which had a standard deviation of 14.1. The single best factor for predictive purposes was the grade nine mathematics mark which had a correlation of 0.675 with the criterion. Two other variables also had a correlation with the criterion which was significant at the .05 level. These were Educability with a correlation of 0.385 and Modern Mathematics with a correlation of 0.304. This data is shown in Table 10.

As can be seen from Table 10 only three variables have correlations with the criterion which are significant at the .05 level. Furthermore, the power of these variables as predictors is further reduced by

Table 10
Means, Standard Deviations, and Zero-Order Correlations for the Complete Honours Class for 1976-1977 (N=71)

Factor	Mean	Standard Deviation	Correlation with Criterion (X_7)	Percent of Variance Accounted For
X_1	85.0	15.1	.385*	14.8
X_2	74.7	20.6	.094	0.9
X_3	76.4	19.9	.304*	9.2
X_4	75.5	18.5	.184	3.3
X_5	79.5	14.1	.126	1.6
X_6	84.7	6.8	.675*	45.6
X_7	67.2	14.2	1.000	

*Significant value of r at the .05 level is 0.232.

the fact that they all have intercorrelations which are significant at the .05 level. These intercorrelations are shown in Table 11. When the stepwise multiple regression procedure was applied the first variable to enter the equation was X_6 followed in the next step by X_1. However, because of the high intercorrelations of X_6 and X_1 with X_3, the next variable that was entered by the regression analysis was X_4 which had a correlation coefficient of 0.184 with the criterion, and this is not significant at the .05 level. In fact, X_3 did not enter until the fifth step in the regression process—and thus could not be used since variables with correlation coefficients not significant at the .05 level would have to be used. The resulting equation obtained from the stepwise regression analysis was $y = 1.28X_6 + 0.20X_1 - 58.1$, and this is shown in Table 12.

Table 11
Intercorrelations Among All Variables for the Complete Honours Class for 1976-1977 (N=71)

	X_1	X_2	X_3	X_4	X_5	X_6	X_7
X_1	1.00	.482	.510	.640	.407	.285	.385
X_2		1.00	.520	.825	.396	.083	.094
X_3			1.00	.788	.432	.384	.304
X_4				1.00	.458	.270	.184
X_5					1.00	.177	.126
X_6						1.00	.675
X_7							1.00

Significant value of r at the .05 level is 0.232.

Table 12
Best Predictive Combinations for the Complete Honours Class for 1976-1977

Factors	Percent of Variance	Multiple R	Equation	Standard Error of y	Probability Level
X_6	45.6	.675	$y = 1.41X_6 - 51.9$	10.5	.0000
X_6X_1	51.9	.720	$y = 1.28X_6 + 0.20X_1 - 58.1$	10.2	.0000

Regression Analysis for School A Using Data From All Three Years

The Honours mathematics course has now been in at the grade ten level for three years. Consequently, there was data available on all the students who had completed the Honours program during that time. In an attempt to utilize all the data that was available, the investigator decided to pool all the subjects from a given school together and consider the pooled data from the three years as a single group for analysis purposes. The result was that because of the much larger numbers involved, a much smaller correlation was necessary for a variable to be significant at the .05 level. However, by pooling the three years together, variances due to teaching methods and course content were not accounted for. Course content is a variance because a given class may or may not have done the Honours course in grade nine, and, as was noted earlier in the thesis, this fact is not indicated on the students' records.

It is interesting to note that the pooled data for school A had many similarities with the data from the school year 1976–1977. For example, the highest mean score for the SRA subtests was again in the Educability subtest which had a mean of 83.2 and the lowest mean was again in the Modern Mathematics subtest which had a mean of 77.3. The greatest variance was still in Reading with a standard deviation of 17.6 and the least variance was still in Science Methodology with a standard deviation of 12.2. Another common element was the fact that the variable with the greatest correlation with the criterion was the grade nine mathematics mark, which was 0.586. These relationships are shown in Table 13.

Table 13
Means, Standard Deviations, and Zero-Order Correlations for School A for Data from the Three Years 1974-1975, 1975-1976, 1976-1977 (N=92)

Factor	Mean	Standard Deviation	Correlation with Criterion (X_7)	Percent of Variance Accounted For
X_1	83.2	15.5	.265*	7.0
X_2	80.2	17.6	.150	2.3
X_3	77.2	16.0	.277*	7.7
X_4	78.1	14.8	.317*	10.0
X_5	81.5	12.2	.233*	5.4
X_6	86.2	6.6	.586*	34.3
X_7	72.4	12.7	1.000	

*Significant value of r at the .05 level is 0.205.

Considering Table 13 it can be seen that five of the factors have a correlation with the criterion that is significant at the .05 level. These coefficients range from a high of 0.586 for the grade nine mathematics mark to a low of 0.233 for the Science Methodology score. However, as can be seen in Table 14, these variables are all intercorrelated, most of them beyond the critical value for the .05 level.

The interesting point about the regression equation derived from this data was the fact that variable X_4 was the last to enter the stepwise regression process even though its correlation of 0.317 was the second largest zero-order correlation coefficient obtained. Consequently, the b weight of 0.152 had a standard error of 0.184 and was thus not significantly different from zero. This is explained by the very high correlations (see Table 13, p. 52) between X_4 and the other variables,

Table 14
Intercorrelations Among All Variables for School A
for Data from the Three Years 1974-1975,
1975-1976, 1976-1977 (N=92)

	X_1	X_2	X_3	X_4	X_5	X_6	X_7
X_1	1.00	.574	.491	.702	.333	.202	.265
X_2		1.00	.459	.835	.298	.147	.150
X_3			1.00	.664	.334	.273	.277
X_4				1.00	.359	.323	.317
X_5					1.00	.172	.232
X_6						1.00	.586
X_7							1.00

Significant value of r at the .05 level is 0.205.

which is understandable since it is the Composite score. Also, although variable X_3 has a correlation with the criterion which is significant at the .05 level, its b weight is not significantly different from zero. The regression analysis yielded the equation $y = 1.04X_6 + 0.10X_5 - 34.2$, and this is shown in more detail in Table 15.

Table 15
Best Predictive Combinations for School A Using
Data from 1974-1975, 1975-1976, 1976-1977

Factors	Percent of Variance	Multiple R	Equation	Standard Error of y	Probability Level
X_6	34.4	.587	$y = 1.12X_6 - 24.4$	10.3	.0000
X_6X_1	36.6	.605	$y = 1.06X_6 + 0.13X_1 - 29.7$	10.2	.0000
$X_6X_1X_5$	37.5	.612	$y=1.04X_6+0.10X_1+0.10X_5-34.2$	10.2	.0000

Regression Analysis for School B Using Data from All Three Years

The highest mean score for the SRA subtests was 81.8 in the Educability subtest and the lowest mean score was 78.4 in the Science Methodology subtest which was a bit of a surprise since the Science Methodology subtest had the highest mean score for the 1976-1977 group when they were considered separately. The greatest variance occurred in the Reading subtest which had a standard deviation of 18.1 and the least variance was in the Composite subtest which had a standard deviation of 14.2. The single factor with the highest correlation with the criterion was again the grade nine mathematics mark which had a correlation of 0.681. These relationships are presented in Table 16.

Table 16
Means, Standard Deviations, and Zero-Order Correlations for School B for Data from the Three Years 1974-1975, 1975-1976, 1976-1977 (N=37)

Factor	Mean	Standard Deviation	Correlation with Criterion (X_7)	Percent of Variance Accounted For
X_1	81.8	16.5	.231	5.3
X_2	79.4	18.1	.066	.4
X_3	79.3	17.3	.190	3.6
X_4	80.6	14.2	.169	2.9
X_5	78.4	17.4	− .100	1.0
X_6	86.1	6.7	.681*	46.4
X_7	66.9	13.8	1.000	

*Significant value of r at the .05 level is 0.325.

The grade nine mathematics score is the only one which has a correlation with the criterion which is significant at the .05 level, and consequently it was the only one used in the regression equation which turned out to be $y = 1.40X_6 - 53.3$. The intercorrelations are given in Table 17 and the equation analysis is given in Table 18.

Table 17
Intercorrelations Among All Variables for School B for Data from the Three Years 1974-1975, 1975-1976, 1976-1977 (N=37)

	X_1	X_2	X_3	X_4	X_5	X_6	X_7
X_1	1.00	.581	.541	.657	.066	.136	.231
X_2		1.00	.416	.799	.304	-.086	.066
X_3			1.00	.749	.226	.250	.190
X_4				1.00	.329	.243	.170
X_5					1.00	-.151	-.100
X_6						1.00	.681
X_7							1.00

Significant value of r at the .05 level is 0.325.

Table 18
Best Predictive Combinations for School B Using Data from 1974-1975, 1975-1976, 1976-1977

Factors	Percent of Variance	Multiple R	Equation	Standard Error of y	Probability Level
X_6	46.4	.681	$y = 1.40X_6 - 53.3$	10.2	.0000

Regression Analysis for School C Using Data from All Three Years

The SRA subtest with the greatest mean again proved to be the Educability subtest with a mean of 82.1. The lowest mean for the SRA subtests was 71.9 in the Science Methodology subtest. The greatest variance was in the Modern Mathematics which had a standard deviation of 21.4 and the least variance was in the Science Methodology subtest which had a standard deviation of 16.2. The variable with the greatest zero-order correlation was the Modern Mathematics score, X_3, which had a correlation of 0.413. This case was different from all the rest in that respect, since all other groups had the grade nine mathematics mark as the greatest zero-order correlation. A possible explanation of this will be given in the next chapter. The other statistics can be seen in Table 19 and Table 20.

Table 19
Means, Standard Deviations, and Zero-Order Correlations for School C for Data from the Three Years 1974-1975, 1975-1976, 1976-1977 (N=43)

Factor	Mean	Standard Deviation	Correlation with Criterion (X_7)	Percent of Variance Accounted For
X_1	82.1	18.3	.361*	13.0
X_2	74.6	21.3	.187	3.5
X_3	74.5	21.4	.413*	17.0
X_4	74.9	19.7	.230	5.3
X_5	71.9	16.2	.083	.7
X_6	81.8	8.8	.299*	8.9
X_7	70.9	12.7	1.000	

*Significant value of r at the .05 level is 0.297.

Table 20
Intercorrelations Among All Variables for School C for Data from the Three Years 1974-1975, 1975-1976, 1976-1977 (N=37)

	X_1	X_2	X_3	X_4	X_5	X_6	X_7
X_1	1.00	.281	.496	.472	.323	.167	.361
X_2		1.00	.557	.832	.242	−.193	.187
X_3			1.00	.805	.241	.033	.413
X_4				1.00	.326	−.101	.230
X_5					1.00	.128	.083
X_6						1.00	.299
X_7							1.00

Significant value of r at the .05 level is 0.297.

Although variable X_1 has the second highest zero-order correlation with the criterion it does not enter until the third step of the analysis and its b weight is not significantly different from zero. The equation that was derived was $y = 0.40X_6 + 0.24X_3 + 19.5$ which is shown in Table 21. It is important to note that this equation only accounts for 25.2 percent of the variance in the criterion.

Table 21
Best Predictive Combinations for School C Using Data from 1974-1975, 1975-1976, 1976-1977

Factors	Percent of Variance	Multiple R	Equation	Standard Error of y	Probability Level
X_3	17.1	.414	$y = 0.245X_3 + 52.6$	11.7	.005
X_6X_3	25.2	.502	$y = 0.41X_6 + 0.24X_3 + 19.5$	11.2	.003

Regression Analysis for Complete Honours Classes Using Data from 1974-1975, 1975-1976, 1976-1977

The data for this analysis is simply the pooled data from the three schools for the three years covered by the study. Again predictive efficiency failed to be improved by the larger numbers involved. The highest mean score was the Educability score of 82.6 and the lowest was the Modern Mathematics score of 77.0. The greatest variance was in Reading which had a standard deviation of 18.7 and the least variance was in Science Methodology which had a standard deviation of 15.0. The single best factor with the highest zero-order correlation was the grade nine mathematics mark which had a correlation of 0.492. The next best correlation was 0.284 between the Educability factor and the criterion. Also the Modern Mathematics score had a correlation of 0.282 with the criterion. These relations, plus the intercorrelations can be seen in Table 22 and Table 23.

The regression analysis yielded an equation which contained only three variables which had weight coefficients significantly different from zero at the .05 level. The resulting equation was $y = 0.77X_6 + 0.11X_1 + 0.09X_3 - 11.4$. The rest of the analysis can be seen in Table 24.

Comparison of Means Test for 1976-1977 Data

As was stated earlier, the only means that were subjected to a one-way analysis of variance with an F-test, were the means of the Honours mathematics mark for grade ten. Here the mean scores of the students from the three different schools were compared to see if the groups differed in their performance in the Honours course. The mean

Table 22
Means, Standard Deviations, and Zero-Order Correlations
for the Complete Honours Class for 1974-1975,
1975-1976, 1976-1977 (N=172)

Factor	Mean	Standard Deviation	Correlation with Criterion (X_7)	Percent of Variance Accounted For
X_1	82.6	16.4	.284*	8.1
X_2	78.6	18.7	.140	2.0
X_3	77.0	17.7	.282*	8.0
X_4	77.8	16.1	.242*	5.9
X_5	78.4	15.0	.106	1.1
X_6	85.1	7.5	.492*	24.2
X_7	70.8	13.0	1.000	

*Significant value of r at the .05 level is 0.195.

Table 23
Intercorrelations Among All Variables for the
Complete Honours Class for 1974-1975,
1975-1976, 1976-1977 (N=172)

	X_1	X_2	X_3	X_4	X_5	X_6	X_7
X_1	1.00	.482	.500	.608	.257	.175	.284
X_2		1.00	.487	.826	.300	.018	.140
X_3			1.00	.733	.280	.195	.282
X_4				1.00	.343	.172	.242
X_5					1.00	.139	.107
X_6						1.00	.492
X_7							1.00

Significant value of r at the .05 level is 0.195.

Table 24
Best Predictive Combinations for the Complete Honours Class for 1974-1975, 1975-1976, 1976-1977

Factors	Percent of Variance	Multiple R	Equation	Standard Error of y	Probability Level
X_6	24.2	.492	$y = 0.86X_6 - 2.2$	11.7	.0000
X_6X_1	28.3	.532	$y = 0.80X_6 + 0.16X_1 - 10.3$	11.1	.0000
$X_6X_1X_3$	29.4	.542	$y=0.77X_6+0.11X_1+0.09X_3-11.4$	11.0	.0000

score for school A was 67.8 with a standard deviation of 14.9. The mean score for school B was 61.6 with a standard deviation of 13.6. The mean score for school C was 70.2 with a standard deviation of 14.1. The F-ratio value was 2.01 which had a probability level of 0.14 and thus the difference in the groups failed to be significant at the .05 level. Since the F-test failed to show any significant difference at the .05 level, the Scheffe coefficients were really not necessary. They are included in Table 25 simply for the sake of completeness and the added information they might give to the school administration.

Table 25
Means, Standard Deviations, and Scheffe Probabilities for Schools A, B, and C for 1976-1977 Data

School	Number	Mean	Standard Deviation	Scheffe Probabilities A	B	C
A	27	67.8	14.9	1.00	.365	.819
B	17	61.6	13.6		1.00	.147
C	27	67.2	13.2			1.00

Comparison of Means Test for Data from All Three Years

Using the data from all three years, school A had a mean score of 72.4 with a standard deviation of 12.7, school B had a mean of 66.9 with a standard deviation of 13.8, and school C had a mean of 72.1 and a standard deviation of 13.2. The F-test value of 2.50 failed to be significant at the .05 level, and hence again the Scheffe test was not necessary. However, the difference is significant at the .085 level, so the results of the Scheffe are included in Table 26 in case the school administration might wish to do further study on the matter.

Table 26
Means, Standard Deviations, and Scheffe Probabilities for Schools A, B, C for 1974-1975, 1975-1976, 1976-1977 Pooled Data

School	Number	Mean	Standard Deviation	Scheffe Probabilities A	B	C
A	92	72.4	12.7	1.00	.102	.988
B	37	66.9	13.8		1.00	.172
C	61	72.1	13.2			1.00

CHAPTER 5

DISCUSSION OF RESULTS

The major purpose of the investigation was to determine the predictive efficiency of the Science Research Associates High School Placement Test Educability score, Reading score, Modern Mathematics score, Science Methodology score, and Composite score, as well as the predictive efficiency of the grade nine mathematics mark received by the students from each of the three schools involved. Zero-order correlations showed the best single predictor to be the grade nine mathematics mark in seven of the eight groups considered. The one exception was school C when all the data for the three years was pooled together. In that case the Modern Mathematics mark proved to be the best single predictor with a correlation of 0.413. For the other eight cases the correlations for the grade nine mathematics mark ranged from a low of 0.492 for the complete Honours class for the pooled data to a high of 0.714 for school A for the 1976-1977 data.

The fact that it was the grade nine mathematics mark that was the best predictor supports the findings of Travers (1955), quoted earlier in this thesis, that once high school is reached there is evidence that a student's grade in a particular subject matter field can be best predicted from his previous grades in the same or related fields. Also, it is very important to note that the zero-order correlations obtained in this study, ranging from 0.413 to 0.714, compare quite favorably with the results of similar studies. For example, Koba (1974) found zero-order correlations ranging from 0.20 to 0.68, Howlett (1969) found zero-order correlations in the area of 0.4 with the highest being 0.404 between the school class rank and the analytical geometry grade, Wampler (1966) found zero-order correlations ranging from 0.251 to 0.853, and finally, Wilbur (1973) found the best correlations to be 0.734 between a student's grade in plane geometry and his grade in intermediate algebra.

However, something more than zero-order correlations were desired from this study. The effect of combining variables to form multiple predictors using regression analysis was considered. The result was that the grade nine mathematics mark (X_6) had the greatest b weight in all eight regression equations. The SRA Educability score (X_1) appeared in five of the eight equations and carried the second highest b weight in each of them. Two of the regression equations contained three variables, though not the same three in both cases. Five of the equations contained two variables and only one equation contained just one variable. These equations are shown in Table 27. The multiple correlations for the composite predictors ranged from a low of 0.502 to a high of 0.756 with a mean value of 0.667. These multiple correlations also compare quite favorably with other studies. For example, Howlett (1969) found the optimum multiple correlation to be 0.589, Koba (1974) found multiple correlations ranging from 0.39 to 0.75, and Strahler (1972) found the highest multiple correlation to be 0.602 but this was when seven variables were considered and she recommended dropping the last four since they were not statistically significant.

It is interesting to speculate as to why school C differs from the other two in the basic format of the equation. The reason why the

Table 27
Optimum Regression Equations for All Eight Groups

School	Data Source	Factor with Largest r	Multiple R	Equation
A	1976-77	X_6	.756	$y = 1.44X_6 + 0.26X_1 - 75.9$
B	1976-77	X_6	.754	$y = 0.90X_6 + 0.54X_1 - 60.5$
C	1976-77	X_6	.685	$y = 1.27X_6 + 0.09X_3 - 44.7$
Pooled	1976-77	X_6	.720	$y = 1.28X_6 + 0.20X_1 - 58.1$
A	All 3 yrs.	X_6	.612	$y = 1.04X_6 + 0.10X_1 + 0.10X_5 - 34.2$
B	All 3 yrs.	X_6	.681	$y = 1.40X_6 - 53.3$
C	All 3 yrs.	X_3	.502	$y = 0.41X_6 + 0.24X_3 + 19.5$
Pooled	All 3 yrs.	X_6	.542	$y = 0.77X_6 + 0.11X_1 + 0.09X_3 - 11.4$

SRA Modern Mathematics score (X_3) is chosen over the Educability score (X_1) is probably due to the fact that students from school C write the SRA Placement Test while they are in grade eight whereas the other two schools write it in grade nine. Why the SRA Modern Mathematics score (X_3) is the single best predictor for the data from all three years instead of the grade nine mathematics mark, the investigator leaves to the school administration to interpret. It is interesting that the school mark is not as reliable a predictor as the standardized test score.

In terms of the secondary purpose of the investigation, it was noted that the difference in the mean scores on the grade ten Honours course was not significantly different at the .05 level. However, it is very important to note that only 37 pupils came from school B but 92 came from school A. Now if only the top 37 from school A had been admitted to the grade ten Honours course, or if another 55 had been admitted from school B, the comparison might surely have been different. What this study says is that there is no difference between the students who are chosen to enter the grade ten Honours course from the three different schools in terms of their performance in the course. However, what is important to note is the number of such capable students who are chosen from schools of approximately equal enrollments.

CHAPTER 6

SUMMARY, CONCLUSIONS, RECOMMENDATIONS

Summary

The major purpose of this investigation was to determine the predictive efficiency of the Science Research Associates High School Placement Test Educability score, Reading score, Modern Mathematics score, Science Methodology score, and Composite score, as well as the predictive efficiency of the grade nine mathematics mark received by each student in predicting success in the grade ten Honours course. The subjects used were 191 boys enrolled in the grade ten Honours course at Brother Rice High School in St. John's, Newfoundland, during the school years 1974-1975, 1975-1976, 1976-1977. The procedure used to determine the predictive efficiency was a stepwise multiple regression analysis developed by Draper and Smith (1966) and programmed for the IBM 360/370 computer by Carlson and Hazlett (1969).

The result was that multiple regression equations using the grade nine mathematics mark and the SRA Educability score were found for six of the eight groups considered. The other two groups had multiple regression equations using the grade nine mathematics mark and the SRA Modern Mathematics score. The best single predictor in all cases except one was the grade nine mathematics mark. The multiple correlation coefficients ranged from 0.502 to 0.756 with a mean multiple correlation of 0.667.

The secondary purpose of the investigation was to determine if the school which a student attended prior to coming to Brother Rice High School had any effect on his performance in the grade ten Honours course. To do this a one-way analysis of variance with an F-test was performed by a computer program written by Hunka and Bay (1969) for the IBM 360/370. No significant difference between the means for the different schools was found at the .05 level.

Conclusions

1. The zero-order correlations between the best of the predictors and the criterion, ranging from 0.492 to 0.714, were as good as those found by most studies referred to in the review of the literature.

2. Of all the variables considered, the grade nine mathematics mark contributed most to the variance of the criterion as can be seen by the fact that the weight for this variable was greatest in all the regression equations obtained.

3. The multiple correlations between the best combination of predictors and the criterion, ranging from 0.502 to 0.756, were also as good as those found by most studies referred to in the literature review.

4. Multiple regression equations can be found which will account for about 44 percent of the variance on the average. These equations will most often involve the grade nine mathematics mark and the SRA Educability score.

5. For neither grouping of the data were the means of the criterion significantly different at the .05 level.

Recommendations

1. The regression equations developed by this study should be cross-validated on the students entering the grade ten Honours course at Brother Rice High School for the school year 1977-1978. Cross-validation is a statistical procedure which tests the validity of a regression equation by comparing the values of the criterion predicted by it to the actual values of the criterion that were obtained. After such a cross-validation, the equations could be used as an integral part of the placement procedure at Brother Rice High School.

2. Because the SRA High School Placement Test did not contribute much to the predictive power of the equation, except the Educability score, another study should be done to determine its predictive efficiency in other subject areas and other courses. The results of this study could help determine if another more suitable standardized test is necessary, or if the SRA test is adequate. Possibly only the Educability subtest is sufficient.

3. Similar studies should be done in other schools which have the Honours course in grade ten and the information pooled so that if a school has a factor which they find particularly good at predicting success in the grade ten Honours course then other schools may try it. That is not to say that they should apply the regression equations developed by each other, because this has been shown not to work. However, the factor considered might at least offer some help in placement.

4. Since it has been shown that the grade ten Honours mark can be predicted with a fair degree of accuracy, there is no reason why all schools with a sufficiently large enrollment cannot institute the pro-

gram. They would be able to predict the student's success before he entered and therefore would not have to worry about a student's inability to cope. All they have to do is develop their own placement procedure and refine it to an acceptable level.

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APPENDIX

A THREE LEVELED APPROACH

BACKGROUND INFORMATION

In March, 1972, a conference involving some seventy high school teachers, representative of all areas of the Province, was held at the Confederation Building in St. John's. The main objective of this conference was to determine and appraise the techniques to be used in the Program of Shared Evaluation for Grade XI which had been instituted by the Department of Education. One significant outcome of this meeting concerned the existing secondary school mathematics program. There was a strong feeling evident among the teachers present that the program was not meeting the needs of most students. This group suggested that a more diversified program in mathematics would be desirable and urged that efforts be made to provide such a program for the secondary school curriculum.

This recommendation was supported by feedback from those in post-secondary institutions who admitted that many students came to them unable to undertake effectively the mathematics program which was being offered--a program for which they had supposedly been prepared. Those in the technical and commercial fields asserted likewise that the mathematics preparation of many wishing to enter these areas was unrealistic and impractical.

The feedback from all involved seemed to center on two main points:

(1) that the existing program was too theoretical, too sophisticated in its emphasis on the structure of mathematics, for the large majority of students.

(2) that the present 'General Program' was serving only a small group and even then not meeting the needs of this group.

It was fe[illegible] that often both programs were being modified greatly at the local school level hopefully to make them more applicable but consequently causing more problems for subsequent programs. Hence, the need for a greater diversification in program offerings in mathematics was obvious.

As a result of these factors, the Provincial Mathematics Committee undertook to develop a mathematics program which would meet the needs of a larger majority of students. This program would be of such scope and flexibility as to provide adequately for the variety of mathematical ability, aptitude and future career choices of all students. The program, which the committee has been developing, is referred to as the Tri-level program. It involved the outlining of three broad classifications of mathematics which have been called by the committee Matriculation Math, Honours Math, Basic Math.

Description of the Tri-level Program

This more diversified program in Mathematics involved the development of a core academic program--Matriculation Mathematics. This program is designed to be taken by the majority of students (approximately 70%). The program allows students of average and below average ability in mathematics to be exposed to essential topics in Algebra, Geometry, Trigonometry and Arithmetic, utilizing an approach and pace of presentation which will maximize success. In effect then, Matriculation Mathematics is a course which develops topics placing greater emphasis on practical applications, provision for more practice with a de-emphasis on involved mathematical terminology and careful provision for the greater readability and reading level of the text which is being used. This course should allow students to obtain a mathematics course which prepares them for the pursuit of a variety of avenues at the post-secondary level.

A more enriched and challenging mathematics program is proposed for the more able student. This program, termed Honours Mathematics, develops many of the core topics in Matriculation Mathematics to a more detailed stage. Also the variety of topics is increased so as to provide students the opportunity to explore more interesting and challenging topics. This program also emphasizes the structure of mathematics allowing students an opportunity to gain a strong mathematics base as well as an appreciation for the total discipline. The program is applicable to students of superior mathematical ability who enjoy the subject and who many foresee future careers in related fields.

Another course designed for students with low academic ability has been initiated in addition to the two academic courses. This program, called Basic Mathematics, emphasizes basic practical applications of mathematics, computation and basic arithmetic. This course attempts to make students functional in basic arithmetic, and presents some applications for daily living. The Basic Mathematics program is suitable for the lower 10–20% of the students. At this point it may be necessary to provide a variety of course offerings in the 'Basic' area so as to more adequately meet varying needs of students in this area.

MATRICULATION MATHEMATICS

General Objectives of Matriculation Mathematics Program:

1. To offer a mathematics program in which essential mathematical concepts and skills are adequately presented utilizing a practical approach, with emphasis on applications and practice rather than emphasis on involved mathematical structure and terminology.
2. To provide a mathematics program which will enable students to acquire the knowledge and essential concepts and skills needed for further educational pursuits, commercial, economic and social endeavours in the life area of their choice.

Description of Students for whom Matriculation Mathematics is Designed:

The student for whom Matriculation Mathematics is designed is one who has an average general ability in Mathematics. This student may have been meeting with a high degree of success throughout his school life. He is one who has a greater degree of success when concepts are presented in a manner which de-emphasises mathematical vigor and emphasises practical applications and logical reasoning. He may find difficulty with independent concept development but usually attains the essence of the concept with instruction and practice.

These students may vary greatly in levels of ability and achievement, stretching from low to very high academic competency. Many such students will have aspirations towards some form of post secondary education be it trades, technological, university or other.

It is hoped that this course will assist such students attain a greater degree of achievement in Mathematics since it makes provision for more time and practice to cover topics than does the Honours Program.

Course Outline -- Matriculation Mathematics

HONOURS MATHEMATICS

Objectives of the Honours Mathematics Program:

1. To provide a more challenging program than was previously available to the mathematically gifted student.
2. To provide a program which emphasises the developmental and structural components of mathematics.
3. To provide recognition of the historical milestones in the development of mathematical ideas--ideas which have helped man in solving many of his problems.
4. To provide awareness of the direct application of mathematics to behavioural, social and applied sciences.

Description of Students in the Honours Stream:

The student for whom Honours Mathematics is designed is one who experiences little difficulty with mathematics. He is one who has a high degree of reasoning power and can perceive abstract relationship readily. He enjoys mathematics and has an appreciation for it as a discipline with a defined structure. Such a student welcomes the acquisition of skills and can work independently to develop logical approaches to problem solving. He takes pleasure in the perception of logical patterns displayed in mathematical situations and in his ability to assess the reasonableness of his findings.

Course Outline -- Honours Mathematics

BASIC MATHEMATICS

Objectives of the Basic Mathematics Program:

1. To provide a program which emphasises the practical, social and computational aspects of Mathematics.
2. To provide a program which encompasses constant review and practice with computational skills, mathematics of everyday living (Consumer Math), some 'trades' oriented mathematics and some Mathematics of business.
3. At grades seven and eight--to provide a remedial program which will enable students who have become severely handicapped mathematically the opportunity to improve on the basic skills necessary to achieve success at these levels.

4. At Senior High School level--to provide a program which will expose students to the mathematical concepts which will enable him to enter the work force or some 'trades' oriented program immediately on leaving the educational system.

Description of Students in the Basic Stream:

The student of Basic Mathematics is one who has constantly demonstrated a low level of academic achievement in mathematics specifically and other courses generally. This student has very little ability for abstract logical reasoning and hence has extreme difficulty mastering the concepts which make up traditional Algebra and Geometry courses.

In the past the majority of students in this category would have 'dropped out' of school and entered the work force before completing Grade XI, after meeting with constant failure throughout the educational system. However, many such students attempt to obtain training in 'trades' oriented programs or enter an upgrading program at some future date.

Hence students who fall in this category are in need of a mathematics program that will be of immediate use to him in society.

Course Outline -- Basic Mathematics

The three program options at Grade 9 for 1975-1976 are as follows:

HONOURS MATHEMATICS	Algebra (Johnson)
	Geometry (Moise & Downs)
MATRICULATION MATHEMATICS	Using Algebra (Travers)
	Modern Basic Geometry (Jurgensen)
BASIC MATHEMATICS	Individualized Mathematics (Foley)
	Basic Math I (Mason) -- This is an alternative to the Foley Material

The three streams at the Grade 10 level have occurred in line with those made at the Grade 9 level.

HONOURS MATHEMATICS	Algebra (Johnson)
	Geometry (Moise & Downs)

MATRICULATION MATHEMATICS	Managing Personal Property (Copp Clarke)
	Using Algebra (Travers)
	Modern Basic Geometry (Jurgenson)
BASIC MATHEMATICS	Consumer Related Mathematics (Kravitz)

The three streams at the Grade 11 level are:

HONOURS MATHEMATICS	Algebra and Trigonometry (Johnson)
MATRICULATION MATHEMATICS	Using Advanced Algebra (Travers)
	Modern Basic Geometry (Jurgensen)
BASIC MATHEMATICS	Basic Math II (Ginn)
	Trigonometry (Copp Clarke)

Streaming and Grouping

In discussing the proposed three leveled program with various groups of teachers throughout the Province, many questions are raised regarding the implementation of such a plan in the schools whose organizational frameworks differ to a great degree. This section will discuss some of these questions and provide some general directions with respect to them.

In the large high schools (4-5 classes per grade) throughout the Province implementation of all three levels should not present a problem. In this situation with 150-200 students per grade it seems feasible that one class would be suited for Honours Mathematics while another would be at such a level to be suited for the Basic Mathematics course. This would allow the remaining two or three classes to study the matriculation mathematics course. Streaming with this number of students does not appear to present any great problems.

The school with only one or two classes per grade does present an obvious problem. At the present time in most cases these classes are doing the academic course. It is impossible to expect such a school to stream to any degree. The committee's recommendation in this regard is that the students study the matriculation mathematics stream. Since it is an underlying fact that the matriculation mathematics stream will not prevent entrance to any of the post-secondary institutions, this recommendation seems to be the most obvious.

One other case has been brought up which may be the most frequent of all. This situation is the one with three classes per grade. At present perhaps two of the three are studying the academic program while the third is working with the general course.

It is difficult to outline any definite policy in this regard since the level of the students may vary from situation to situation. However, if the present general students handle this program with no apparent difficulty but would find the present academic too vigorous it might seem feasible that they could study with success the new Matriculation mathematics. The situation then might see all three classes with the Matriculation program, or perhaps one with the Honours program and two with the Matriculation program. However, if the Matriculation stream does what it should--meet the needs of the average students, it is the committee's feeling that it may be a suitable course for many of our present general students.

One final point is worth consideration. While the more appropriate method of grouping is by classes, it is not unknown to conduct two courses within the one classroom. While more planning and preparation are natural prerequisites for such endeavours it is certainly not outside the realm of realistic possibilities. If such in-class grouping could be effected then any school, regardless of its size or administrative make-up, could present more diversified programs and allow for greater individualization.